

# EGRET Likelihood Analysis and the $g_{mult}$ and $g_{bias}$ Parameters

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# Likelihood Analysis Model

- The total model prediction for pixel  $ij$

$$\theta_{ij} = g_{mult} \cdot G_{ij} + g_{bias} \times 10^{-5} \cdot E_{ij} + c_a \cdot PSF(\alpha_a, \delta_a, i, j) + \sum_k c_k \cdot PSF(\alpha_k, \delta_k, i, j)$$

where  $c_a$  are the model counts for the ‘active’ source at  $\alpha_a, \delta_a$ ,  
 $c_k$  are the model counts for the ‘inactive’ sources at  $\alpha_k, \delta_k$ , and  
 $PSF(\alpha, \delta, i, j)$  is the fraction of the PSF located at  $\alpha, \delta$  that is in pixel  $i, j$

- Ideal diffuse counts prediction

$$G_{ij} = \frac{\sum_{kl} E_{kl} \cdot \text{Diff\_model}(k, l) \cdot PSF(\varphi_{ijkl})}{\sum_{kl} PSF(\varphi_{ijkl})}$$

where  $E_{ij}$  is the exposure [ $\text{cm}^2 \text{ s sr}$ ] at pixel  $ij$  and  $\varphi_{ijkl}$  is the angle between pixels  $ij$  and  $kl$

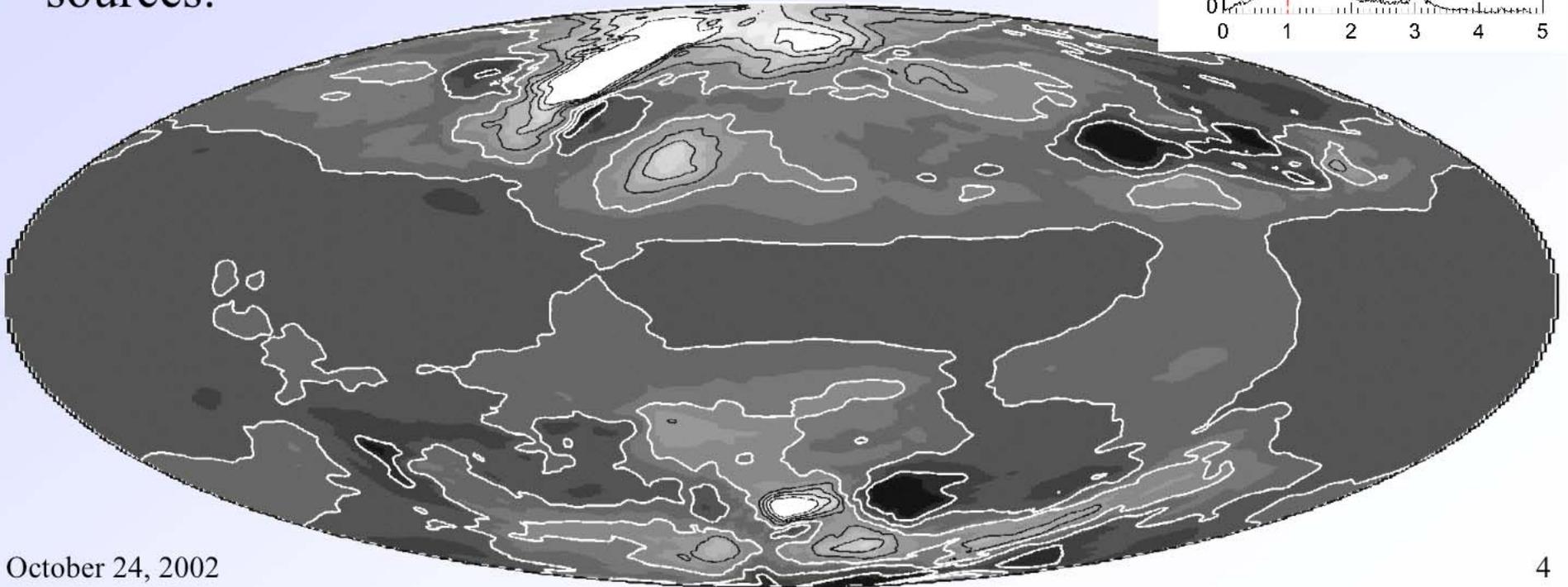
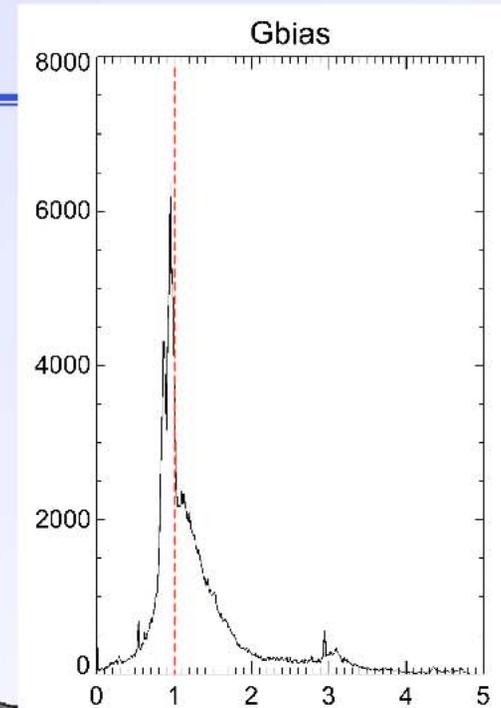
(Mattox, et al. 1996, ApJ, 461, 396-407)

# EGRET Likelihood Parameters

- $g_{\text{mult}} \approx 1.0$ 
  - small spatial scale ‘correction’ to the diffuse model, from e.g. unresolved point source contribution
  - $g_{\text{mult}} \equiv 1$  if the diffuse model is correct
- $g_{\text{bias}} \approx 1.5$  [ $\times 10^{-5} \text{ cm}^{-2} \text{ s}^{-1} \text{ sr}^{-1}$ ] ( $E_{\gamma} > 100 \text{ MeV}$ )
  - the extragalactic diffuse emission
  - not included in the all-sky diffuse model
- $g_{\text{mult}}$ ,  $g_{\text{bias}}$ , and  $c_a$  were simultaneously estimated by maximum likelihood
  - likelihood program included analysis modes in which  $g_{\text{mult}}$  and/or  $g_{\text{bias}}$  could be fixed
  - typically both parameters were estimated

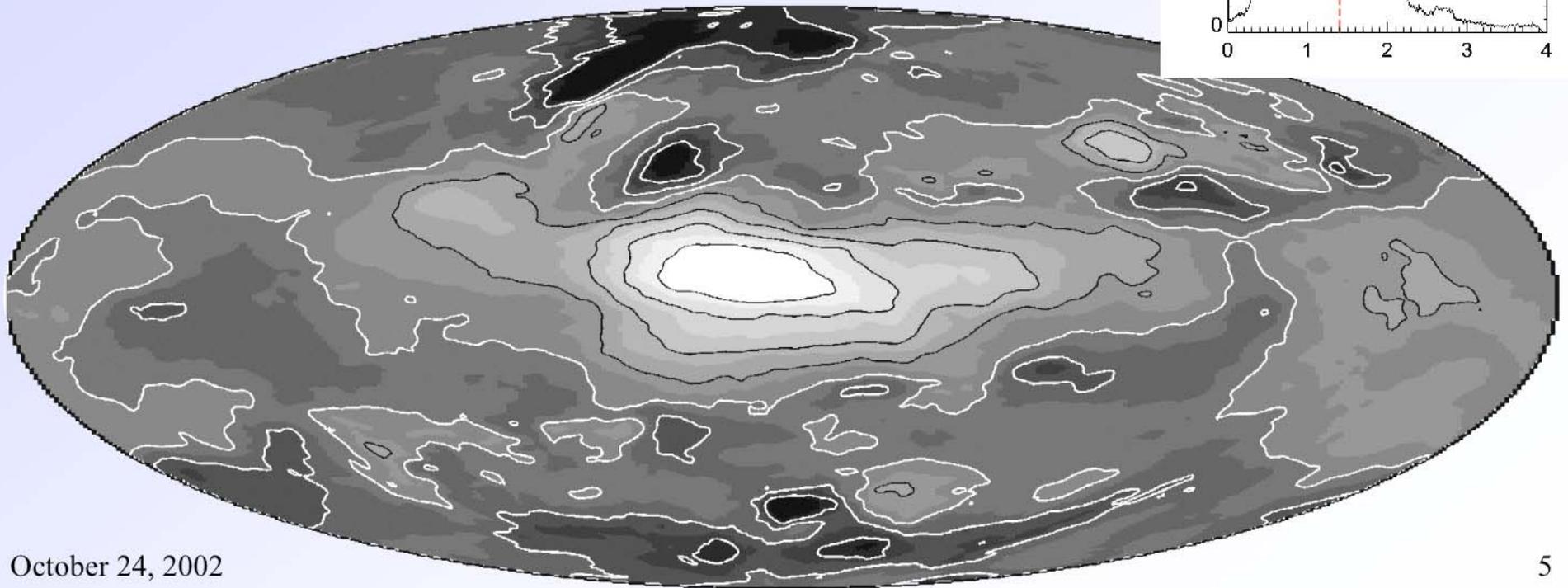
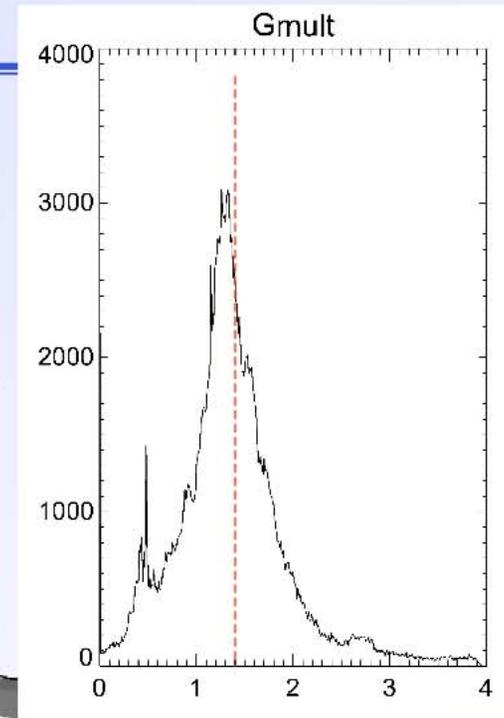
# $g_{mult} - E\gamma > 100 \text{ MeV}$

- From the analysis for the *Third EGRET Catalog* (Hartman et al. 1999, ApJS,123).
- Histogram of  $g_{mult}$  values is quasi-gaussian with a long tail to higher values. Mean is at  $\sim 0.9$ , slightly less than the expected value of 1.0.
- Regions near Gal plane where  $g_{mult}$  is  $> 1.0$  indicate regions of possible contribution from unresolved sources.

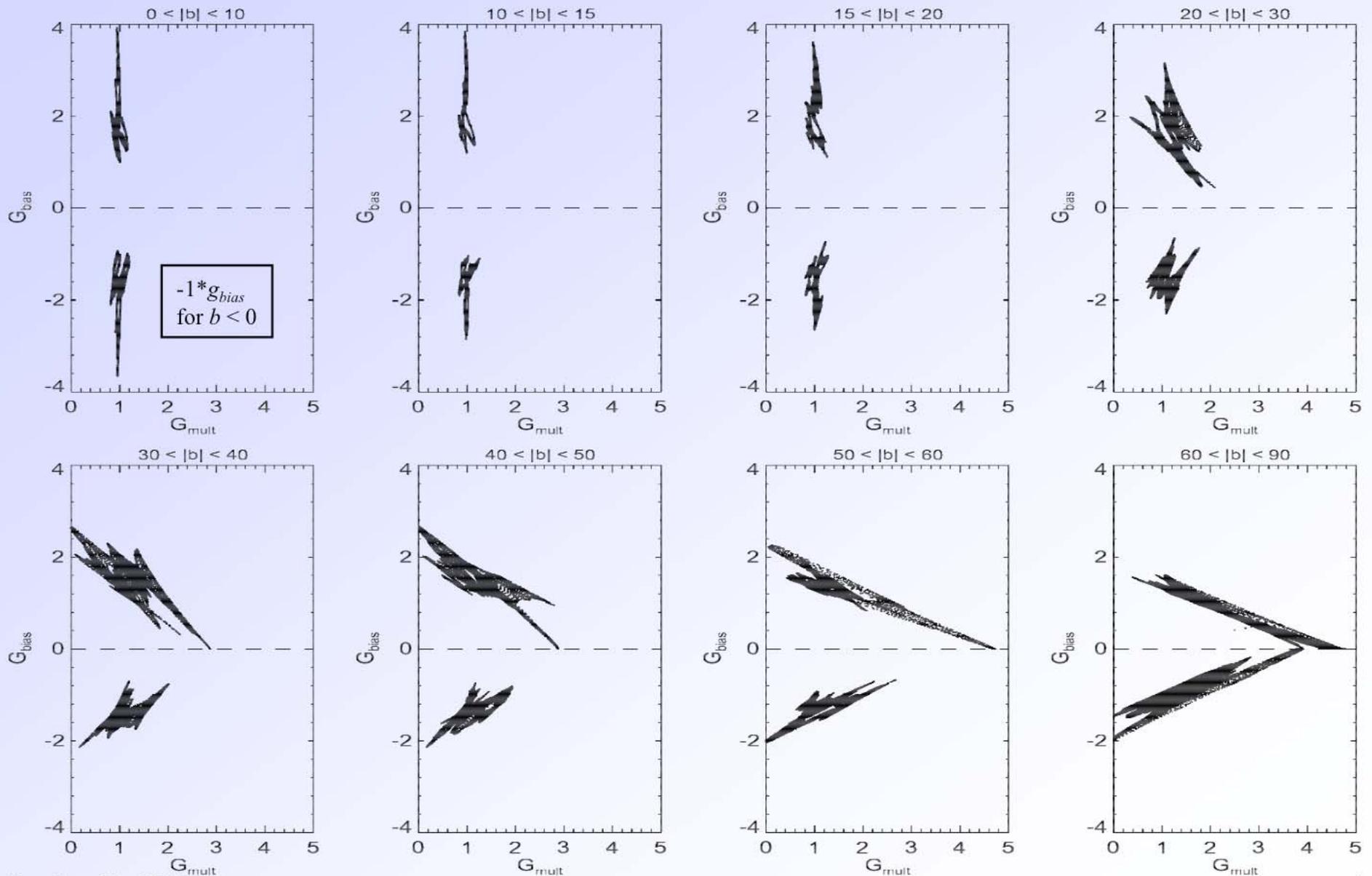


# $g_{bias} - E\gamma > 100 \text{ MeV}$

- From the analysis for the *Third EGRET Catalog* (Hartman et al. 1999, ApJS,123).
- Histogram of  $g_{bias}$  values is quasi-gaussian. Peak is at  $\sim 1.4$ , slightly less than the expected value of 1.5.



# Correlation - Latitude Averages



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# Conclusions

- Near Galactic plane,  $g_{mult}$  is well determined.
  - Indication of unresolved point source in direction of local arm tangent points.
- At higher latitudes, where there is little structure to the Galactic diffuse emission,  $g_{mult}$  and  $g_{bias}$  are strongly anti-correlated.
- Analysis parameters need to be orthogonal.